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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 :		(11) International Publication Number: WO 00/65900
A01G 23/08	A1	(43) International Publication Date: 9 November 2000 (09.11.00)

(21) International Application Number: PCT/FI00/00373

(22) International Filing Date: 28 April 2000 (28.04.00)

(30) Priority Data:
990973 29 April 1999 (29.04.99) FI

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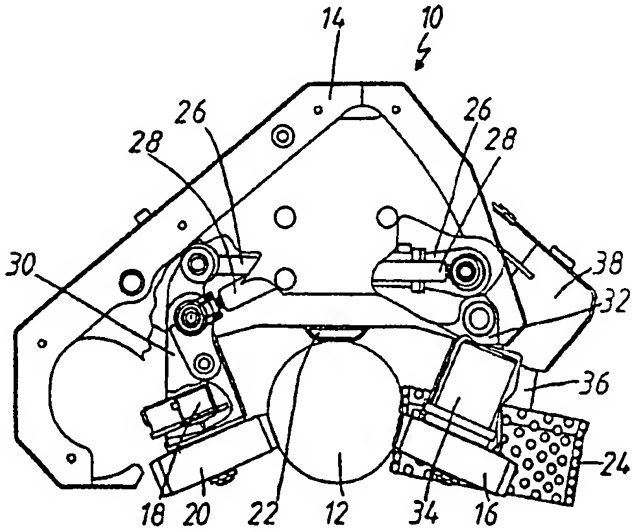
(81) Designated States: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.
In English translation (filed in Finnish).

(54) Title: HARVESTER HEAD AND A METHOD THEREIN



(57) Abstract

This publication discloses a harvester head (10) in a timber harvesting machine and a method therein, the harvester head comprising a body (14) with at least two support and feed members (16, 20) for timber (12) to be handled, the members supporting and transferring timber (12) in the longitudinal direction. The said members (16, 20) are arranged on different sides of the transfer track for timber (12). Of the support and feed members (16, 20), at least one is mechanically operated (16) and at least one is freely rotating (20). Further, the harvester head (10) comprises adjustment members (26, 28) for the reciprocal distance of the said support and feed members (16, 20), and power transmission members (34) for using at least one mechanically operated member (16). The said at least one freely rotating timber support and feed member (20) is provided with a revolution counter (18) for measuring the transfer range of timber (12).

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Harvester head and a method therein

The present invention relates to a harvester head according to the preambles of the claims presented later, and to a method in the harvester head, the harvester head being used for handling timber in logging.

In modern mechanical logging, felling or harvester heads are generally used, which are mounted on different frame machines. The harvester head works so that it is used for gripping the trunk of a tree to be chopped down near the earth surface, and the cutting device in the harvester head, in most cases a chain saw, cuts the tree. The harvester head may also be used for handling already felled timber. The felled trunk is fed through the harvester head so that the blades or other similar members in it prune and/or bark the trunk, and the cutting device cuts it into blocks of suitable sizes. The harvester head is connected to the frame machine, for example a forest machine or an excavator, from which it receives its driving power through transmission members. The control of the harvester head functions and the registration of measuring data may be arranged in different ways, normally with the help of a computer-based measuring and control system designed for the harvester head. An important part of the efficient and exact operation of the harvester head is the measuring of the cutting length of timber to be handled, i.e. the feed length of timber. With the help of exact measuring devices and members providing them with information in the harvester head, timber may be cut exactly to the desired measures and, at the same time, an exact register may be kept, for example, concerning the amount of felled and handled timber.

Typically, the harvester head is attached to the hydraulically operated boom assembly of the frame machine. The members of the harvester head are usually hydraulically or electrically driven and connected to the hydraulic and electrical systems of the frame machine. The driver of the frame machine usually controls and adjusts the functions of the harvester head from the control cabin of the frame machine with the help of so-called control handles, which are connected to the said measuring and control system or device, which again is connected to the electrical and hydraulic system of the frame machine.

In the harvester head, timber is fed or transferred on and with the help of various support and feed members. Generally, they are mechanically operated by hydraulic motors or freely rotating rollers, wheels or rolls, the surface of which is shaped so

that the hold to the trunk remains good, for example with various spikes, ribs or chains. In this text, a mechanically operated roller or other member refers to a member, the rotation of which is controlled by a motor. Freely rotating refers to a member, the rotation of which is not controlled by a motor, but the member is fitted to rotate according to the movement of timber in connection with it. It has to be possible to move at least part of the said support and feed members in relation to each other so that the trunk to be handled is received to the grip of the harvester head. Normally, the harvester heads thus have a clamp-like structure, so that upon gripping the tree, the clamp is opened and set around the trunk. As the trunk is in a suitable position inside the harvester head, the clamp is closed, generally by moving hydraulically movable support, feed or other gripping members. The hydraulically controlled grip of the support and feed members, for example, may have an effect on the hold of the contact between the said members and the trunk. For example, a slippery trunk or a trunk with a large diameter may be pressed with a slightly bigger force than a smaller trunk or well holding timber in order to keep the hold sufficient. As the trunk thus has been gripped, it is made to move in the harvester head in its own longitudinal direction along its transfer track, by using timber feed members being in connection with the trunk. In this way, timber is made to move through the harvester head at the same time as the handling members, such as pruning blades, connected to the harvester head, conduct the pruning. It usually has to be possible to use the feed members in both directions, because timber is not always pruned or barked sufficiently well during single handling.

It is known to measure in different ways the range or length that timber travels in the harvester head. For example, it is known to measure the rotation of the mechanically operated feed rollers or rolls movable in relation to each other. However, when measuring the rotation of a driving roller or roll, the dead rotation of the roller or roll or the slipping of timber causes measuring errors. This is due, for example, to the slippery surface of timber, loose bark or the too low pressing force between the feed member and timber surface.

It is also known to place a measuring sensor to the freely rotating measuring wheel attached to the body of the harvester head. In this case, its pressing force and thus its hold to the trunk cannot actually be adjusted during the handling of the trunk, because, for example, only a spring or a hydraulic cylinder may press the measuring wheel against the trunk with a constant force. In this kind of arrangement, the contact between the measuring wheel and the trunk may even entirely disappear at times, for example, due to a curved trunk. These kinds of measuring members are

also inclined to become blocked, due to tree bark and other rubbish. When the measuring wheel or a similar member becomes blocked, it has to be cleaned for ensuring its rotation. It is usually not possible to clean the measuring wheel stationary in the harvester head without detaching timber under handling from the grip of the harvester head. This takes a lot of time. In some cases, for example, when working in a terrain with slopes, the grip cannot be released. The danger of blocking is especially present when handling timber with a very loose bark, for example, when barking so-called hardwood, such as eucalyptus trees.

The object of the present invention is to provide a device with which the above-mentioned drawbacks in the known technique may be minimised.

The above-mentioned drawbacks may be removed and the objects defined above may be achieved with the harvester head of the invention and with the method in the harvester head, characterised in what is defined in the characterising parts of the independent claims presented below.

It is typical of the device and method of the invention that the body of the harvester head of a timber harvesting machine includes at least two support and feed members for timber to be handled, timber to be handled being transferred in the harvester head in the longitudinal direction with the help of these members. Feeding refers to the transfer of timber to be handled in the harvester head, and the support and feed members refer to the members, with which the said longitudinal transfer is achieved. The substantially straight track, along which timber travels in the harvester head, is called the transfer track for timber. The said at least two support and feed members are fitted on different sides of timber for the smooth support of the timber. Advantageously at least some support and feed members are found substantially at the same level transverse to the said transfer track. Naturally, all the members do not have to be at the said same level, and there may be several said levels, but the members arranged on different sides of the transfer track have to support timber in an even way so that timber is kept straight upon handling. At least one of the said support and feed members is mechanically operated, and at least one rotates freely. The mechanically operated member is required to transmit driving force for making timber to move; preferably, there are at least two mechanically operated members. There may also be several freely rotating members. Of the freely rotating support and feed members, at least one is provided with some kind of a revolution counter, i.e. it works as the measuring member for the transfer range of timber. The revolution counter here refers to any measuring member, with which it is possible to measure the range which the surface of the member against the timber

travels. Naturally, the harvester head of the invention also requires power transmission members, such as a hydraulic or electric motor, for driving the at least one mechanically operated timber support or feed member.

The device of the invention further includes members with which the said support and feed members, or at least some of them, may be transferred in relation to each other, i.e. the reciprocal distance between them may be changed. This mechanism makes it possible for the harvester head to grip the trunk of timber in a clamp-like manner and to press the trunk with desired strength. In the harvester head according to the invention, the freely rotating measuring wheel or a similar member is fitted as a part of the harvester head structure operating in a clamp-like manner.

It is typical of an especially advantageous embodiment of the invention that the support or feed member provided with the revolution counter may be moved separately from some other timber support and feed members, when desired. In other words, the measuring wheel or a similar member may be detached from the timber surface and pressed again against timber at the same time as at least one other support or feed member keeps the timber to be handled in its grip. Such a member provided with the revolution counter may be arranged to be moved on its own or, for example, all support and feed members at the one and same level may be detached from the timber surface simultaneously while the members at the other levels keep timber in place.

In an embodiment of the invention, at least one mechanically operated and at least one freely rotating measuring wheel or a similar member is arranged substantially at the same level transverse to the transfer track of timber to be handled.

It is typical of an advantageous embodiment of the invention that the adjusting members for the reciprocal distance of the timber support and feed members or the transmission members for the mechanically operated timber support and feed member, or both these members are hydraulically driven.

In the harvester head of the invention, the freely rotating member provided with the revolution counter may be detachable from the harvester head and thus changeable to a similar or a mechanically operated support and feed member.

In the harvester head of the invention, the revolution counter has a pulse sensor or some other kind of sensor measuring the feed range.

An advantageous embodiment of the invention comprises data transmission members for transmitting the measuring data from the revolution counter, for example, to the measuring device in the harvester.

The most important advantage of the invention is that the measuring result for the timber feed range and thus the measuring result for the cutting length is exact, as the measuring result genuinely indicates the range travelled by timber, and not the rotation of the mechanically operated member. It is also as assistance for the exactness that the force, with which the freely rotating member provided with the measuring member compresses to the trunk to be handled, may be adjusted to suit the situation at hand, when necessary. Preferably, the timber feed members and member moving members work hydraulically.

An advantage of an advantageous embodiment of the invention is that cleaning the measuring wheel or a similar member, for example, from timber bark is easy and fast, as the said member may be moved separately from some or all other timber support and feed members. Such a measuring wheel or a similar member is easy to clean, and normally it will become clean by itself, by releasing the member from the timber surface while the other support and feed element keep the timber in the harvester head in their grip. After the cleaning, the measuring wheel or a similar member is pressed back against the timber, and the work may be continued. The diameter of the measuring wheel or a similar member of the invention may easily be made larger than the measuring wheel fitted fixedly to the body of the harvester head, so that its measuring exactness becomes better and rubbish will not so easily block it.

An advantage of an embodiment of the invention is that the timber is kept sufficiently straight, as at least one mechanically operated and at least one freely rotating measuring wheel or a similar member is fitted substantially to the same level transverse to the transfer rail of the timber to be handled.

An advantage of an embodiment of the invention is that the freely rotating member provided with the revolution counter may be released from the harvester head, when necessary, for example upon breaking, for service or easy and fast change. The freely rotating member may also be changed to a mechanically operated member which fits into its place.

In one embodiment, an advantage is that the measuring is exact and that the measuring data may be transmitted forward easily, as the revolution counter

includes a pulse sensor, an inductive pair of couplings, a tachometer, or a similar member.

An advantage in one embodiment is that the length measuring data about the transfer range of the timber to be handled may be handled in a versatile, fast and exact way, as the embodiment comprises data transmission members for transmitting the measuring data from the revolution counter, for example, to the measuring and control device in the harvester.

The invention is next described in more detail referring to the enclosed drawing, in which

Fig. 1 shows a harvester head of the invention as a partly cut end view in direction of the transfer track of the timber to be handled.

Fig. 1 shows the advantageous harvester head 10 according to the invention in its operating position. In the figure, the harvester head 10 is presented as a partly cut end view in direction of the transfer track of the timber 12 to be handled, so that the cross section is seen of the timber 12. The harvester head 10 has the body 14, the mechanically operated timber and feed roller 16, the freely rotating measuring wheel for the timber transfer range provided with the revolution counter 18, and the support point 22 stationary in the body 14. The members 16 and 20 are arranged substantially to the same level transverse to the transfer track for the timber 12 to be handled on different sides of the timber to be handled, so that the timber to be handled would be supported from several directions. Further, the second mechanically operated support and feed roller 24 is arranged to the harvester head 10 which, provided with bark-removing members, also barks the timber 12, when necessary. There may be several similar members to the members 16, 20, 22, and 24, and they may be arranged to the same level or a different level as the members 16 and 20 in the figure. Further, the movement of the support and feed members 16 and 20 is shown in the figures, i.e. the members, a hydraulic member 26 and a stabiliser bar 28, guide the distance between the support and feed members, which are arranged to move the arms 30 and 32, when desired. When the arm 30 is moved, also the measuring wheel 20 in connection with it moves. Respectively, when the arm 32 is moved, also the first mechanically operated timber support and feed roller 16 connected to it moves. Thus, in this example, the rollers 16 and 20 always move simultaneously. This is not necessary in the harvester head 10 of the invention, but if desired, the measuring roller 20 may have its own, independently operating position adjustment members 26 and 28. In the example in the figure, the second

mechanically operated roller 24 is arranged to be moved respectively, but the hydraulic members, stabiliser bars, or other similar members are not shown in the figure. Thus, the roller 24 in the example may be moved in relation to the timber 12 to be treated irrespective of the support and feed members 16 and 20. The figure also shows the hydraulic motor 34 used for rotating the first mechanically operated roller 16, and the hydraulic motor 36 used for rotating the second mechanically operated roller 24. The second mechanically operated roller 24 and its driving motor 36 are supported to the body 14 with a support assembly 38. Naturally, there may be more of the above mentioned support and feed members, or members for moving and/or driving them. In addition, the harvester head 10 is generally provided with other members as well, which are not shown in this connection, such as different kinds of blades, saws, sensors, or timber marking devices, and equipment needed for felling timber.

The harvester head 10 is attached to a suitable frame machine, for example an excavator, with connectors and/or coupling members previously known. Further, the hydraulically driven members of the harvester head 10 are hydraulically connected to the hydraulic system in the frame machine in a way known in itself. The frame machine or the connectors, coupling members or hydraulic members connecting it and the harvester head are not shown in the figure. Nor does to figure show the data transmission members advantageously attached to the harvester head 10 of the invention, such as electric wires, through which the measuring signal from the pulse sensor or a similar member comprising the revolution counter 18 is transmitted to the measuring and control device in the frame machine.

The advantageous harvester head 10 of the invention shown in Fig. 1 works in the following way. The harvester head 10 is opened by controlling the members 26 and 28 so that the arms 30 and 32 turn, simultaneously turning the support and feed members 16 and 20 farther away from each other, i.e. away from the transfer track for the timber 12 to be handled. Likewise, the support structure 38 is turned so that also the roller 24 moves away from the transfer track for timber 12. The harvester head 10 now opened is moved around a tree still standing or already felled timber 12, and by guiding the members 26, 28, 30, 32 and 38 to the opposite direction from the previous direction, the harvester head 10 is closed to the desired place, i.e. the members 16, 20 and 24 are pressed against the timber trunk 12. The trunk of a tree 12 not felled is cut by using a cutting saw in the harvester head 10. The cutting saw is not shown in the figure. As timber 12 has been cut, the harvester head 10 and simultaneously timber 12 in its grip, are turned into the working position, i.e.

generally so that the trunk of the timber 12 to be handled is substantially parallel to the earth surface, in practice generally horizontal. The hydraulic member 28 is used to adjust the force, with which the support and feed members 16 and 20 press the trunk, to a desired value. Thus, it is possible to adjust the gripping hold between the support and feed members 16 and 20 and timber 12 suitable for each situation. The roller 24 is pressed against the timber trunk 12 in a respective way.

Timber 12 to be handled is moved in the longitudinal direction, i.e. along the transfer track by using hydraulic motors 34 and 36, arranged to rotate the timber support and feed rollers 16 and 24. The surfaces 16 and 24 of the rollers are shaped so that they get a holding grip of timber 12, thus making timber 12 to move when the rollers 16 and 24 are rotating. The measuring roller 20 arranged to rotate freely and the support point 22 stationary in the body 14 keep the trunk 12 straight as the feed rollers 16 and 24 affect timber 12 from different sides. At the same time, the revolution counter 18 arranged to the measuring roller 20 and its pulse sensor or a similar member give information about the rotating movement of the measuring roller 20, i.e. about the range which timber 12 to be handled has travelled, to the measuring device in the frame machine, the information processed by the measuring device being used for guiding and controlling the operations of the harvester head 10. The measuring results from the revolution counter 18 may, for example, be combined with information from other sensors, such as the timber thickness measuring sensor, so that, for example, the volume of the amount of handled timber may be calculated. In the example in Fig. 1, timber 12 to be handled is intended to be barked so that the feed rollers 16 and 24 release the bark as they feed timber through the harvester head. In the example in the figure, there is shown only one bigger feed roller 24 and one smaller roller 16, with which the trunk 12 may be barked. The barking is not always successfully conducted with one handling, but timber 12 often has to be moved back and forth in the harvester head 10 even several times, so that the hydraulic motors 34 and 36 rotating the rollers 16 and 24 have to work in both directions.

As the timber 12 under handling has been handled in the desired way, the harvester head 10 is opened by controlling the members 26 and 28 so that the arms 30 and 32 turn, simultaneously turning the support and feed members 16 and 20 farther away from each other, i.e. away from the transfer track for timber 12. Likewise, the roller 24 is moved away from the transfer track for timber 12. After this, the part of timber 12 to be handled still remaining in the harvester head is dropped to the desired place, and the harvester head 10 is ready to receive a new trunk 12.

Should the measuring roller 20 become blocked, or should its rotation be prevented even partly in the middle of timber handling, the rollers 16 and 24 may be turned loose from the trunk 12 merely by moving the members 26 and 28. Thus, the roller 20 becomes cleaned by itself, or it may be cleaned without having to release the timber 12 at all from the grip of the harvester head, because the roller 24 is still keeping the timber 12 in its grip.

It is obvious for one skilled in the art that the invention is not merely restricted to the example shown, but the invention may vary within the limits of the patent claims stated below. The device of the invention does not necessarily have to comprise a barking roller, or the harvester head may be provided with some other suitable equipment. The members, motors and power transmission of the harvester head may also be of some other type than hydraulic, for example, electrically driven or driven by a combustion engine. The control and measuring device may consist of several parts, of which one or some may be arranged to the harvester head. The support and feed rollers may be manufactured of any suitable material, or a combination of these, such as metal, plastic, or rubber.

Claims

1. Harvester head (10) for a timber harvesting machine, with a body (14) and in it:

- at least two members (16, 20) for supporting and transferring timber (12) to be handled in the longitudinal direction, the members (16, 20) being arranged on different sides of the transfer track for timber (12), and of which support and feed members (16, 20) at least one is mechanically operated (16) and at least one is freely rotating (20);

- adjusting members (26, 28) for the reciprocal distance of the said support and feed members (16, 20); and

- power transmission members (34) for using at least one mechanically operated timber support and feed member (16);

characterised in that the said at least one freely rotating timber support and feed member (20) is provided with a revolution counter (18) for measuring the transfer range for timber (12).

2. Harvester head (10) of claim 1, **characterised** in that the said adjustment members (26, 28) for distance comprise members (26, 28) for moving the support and feed member (20) provided with the revolution counter (18), the moving members (26, 28) being arranged to operate independently from the at least one other adjustment members for the support and feed member positions, when desired.

3. Harvester head (10) of claim 1 or 2, characterised in that the said support and feed members (16, 20) are substantially arranged to the same level transverse to the timber (12) transfer track.

4. Harvester head (10) of one of the claims 1, 2 or 3, **characterised** in that at least some of the following members are hydraulically driven:

- adjustment members (26, 28) for the reciprocal distance of the timber support and feed members (16, 20);

- power transmission members (34) for using at least one mechanically operated timber support and feed member (16).

5. Harvester head (10) of one of the claims 1, 2, 3 or 4, **characterised** in that at least one freely rotating support and feed member (20) provided with the revolution counter (18) is detachably and thus changeably arranged to the harvester head (10).

6. Harvester head (10) of one of the preceding claims, **characterised** in that the revolution counter (18) is provided with a pulse sensor, an inductive pair of couplings, a tachometer, or a similar sensor measuring the rotating movement.

7. Harvester head (10) of one of the preceding claims, **characterised** in that it further comprises data transmission members for transmitting the measuring data from the revolution counter (18) for handling, for example, to the measuring and control device of the harvester.

8. Method in the harvester head (10) of a timber harvesting machine, in which method:

- timber (12) is supported and transferred in the harvester head (10) in the longitudinal direction at least with one mechanically operated (16) and at least one freely rotating (20) timber support and feed member (16, 20) arranged on different sides of the transfer track; and

- the reciprocal distance of the said support and feed members (16, 20) is adjusted,

the method being **characterised** in that the transfer range of timber (12) is measured with the revolution counter (18) arranged at least to one freely rotating timber support and feed member (20).

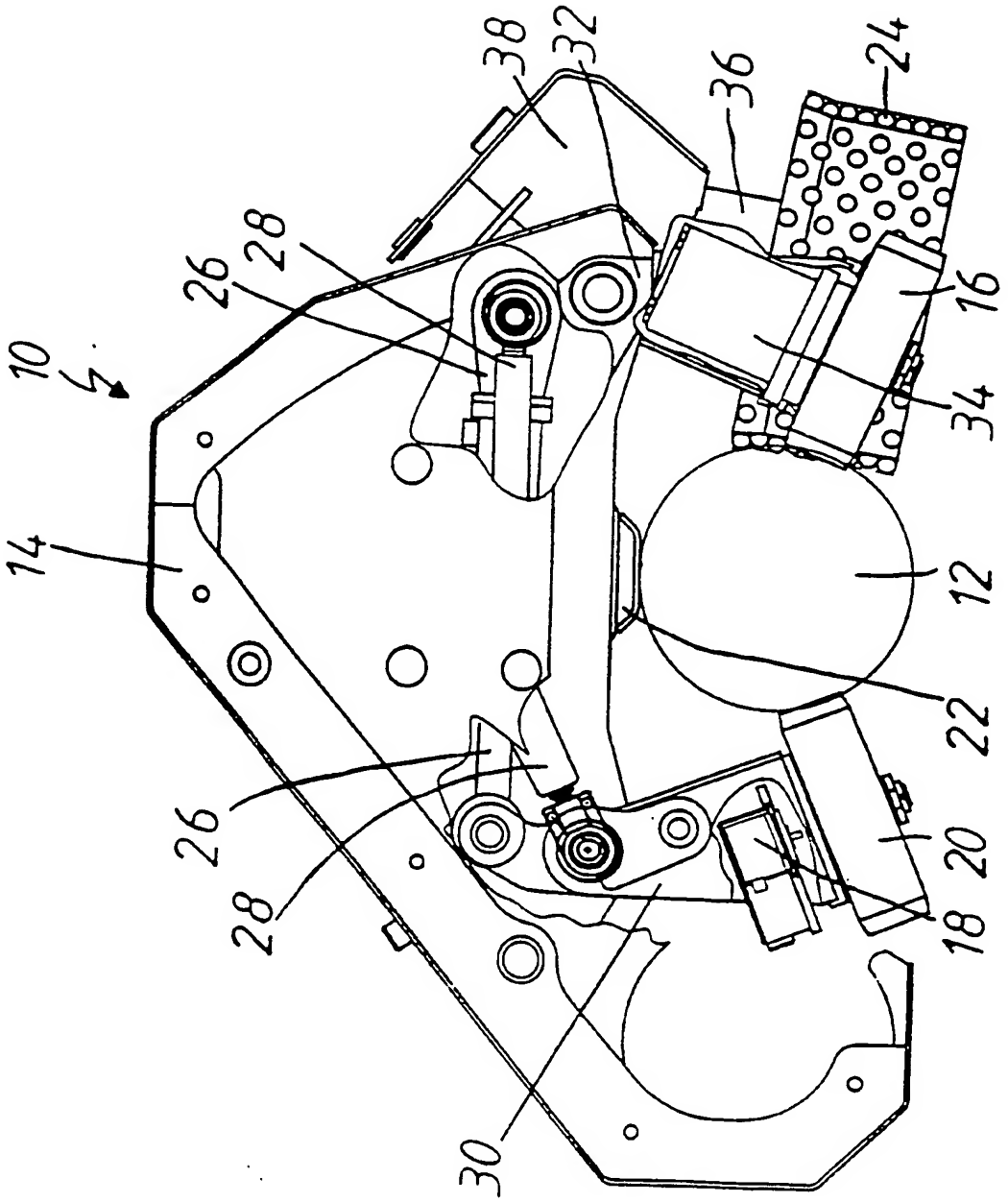

Fig.1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 00/00373

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: A01G 23/08
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: A01G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI,EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5058638 A (GEROLD HACKER ET AL), 22 October 1991 (22.10.91), page 1, column 50 - column 2, line 21 --	1-8
X	WO 9303604 A1 (MOISIO, JUHA), 4 March 1993 (04.03.93), page 3, line 3 - line 10 -- --------	1-8

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
23 August 2000	05 -09- 2000
Name and mailing address of the ISA: Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Eddy Leopold/MP Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

08/05/00

International application No.
PCT/FI 00/00373

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5058638 A	22/10/91	DE 9011682 U	25/10/90
WO 9303604 A1	04/03/93	AT 140362 T	15/08/96
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